

## Two New Deep-Water Pseudolividae (Neogastropoda) from the South-West Pacific

**Philippe Bouchet**

Muséum national d'Histoire naturelle  
55 rue Buffon, 75005 Paris FRANCE  
E-mail: bouchet@cimrsl.mnhn.fr

**Geerat J. Vermeij**

Department of Geology and Center  
for Population Biology  
University of California at Davis  
Davis, CA 95616 USA  
E-mail: vermeij@geology.ucdavis.edu

### ABSTRACT

The new genus *Fusulculus*, conchologically most similar to *Benthobia* Dall, 1889 and *Zemira* H. & A. Adams, 1853, is erected for axially sculptured species of Pseudolividae with shouldered whorls and obsolete labral tooth; the columellar and parietal callus is of very limited extent, and a parietal rib at the adapical end of the inner lip is absent. Two new species, *Fusulculus crenatus* (type of genus) and *F. albus* are described from bathyal (400–800 m) hard bottoms at tropical and subtropical latitudes in the southwest Pacific. No post-Paleocene species of Pseudolividae are known from the tropical Indo-Pacific; the habitat of *Fusulculus* is bathymetrically transitional between those of *Benthobia*, from abyssal depths, and the various genera from subtidal waters in southern Australia, South Africa and Angola.

**Key words:** Muricoidea, Pseudolividae, *Fusulculus*, labral tooth, deep-sea, New Caledonia, New Zealand.

### INTRODUCTION

Among the many remarkable mollusks in the deep-water fauna around New Caledonia are two species that belong to a previously unknown genus of the neogastropod family Pseudolividae. The discovery of these species documents the occurrence of the Pseudolividae at tropical latitudes in the Indo-West-Pacific region, whose enormous molluscan fauna is otherwise wholly lacking in members of this relict family. Here we introduce the new genus *Fusulculus* and describe the two new species belonging to it.

### ABBREVIATIONS USED

LACM Los Angeles County Museum of Natural History, Los Angeles  
MNHN Muséum national d'Histoire naturelle, Paris  
NM Natal Museum, Pietermaritzburg  
NMNZ Museum of New Zealand Te Papa Tongarewa, Wellington

NZOI National Institute of Water and Atmospheric Research [formerly New Zealand Oceanographic Institute], Wellington  
dd empty shell  
lv collected alive.

Superorder CAENOGASTROPODA Cox, 1960  
Order NEOGASTROPODA Wenz, 1938  
Superfamily Muricoidea Rafinesque, 1815  
Family Pseudolividae Fischer, 1854

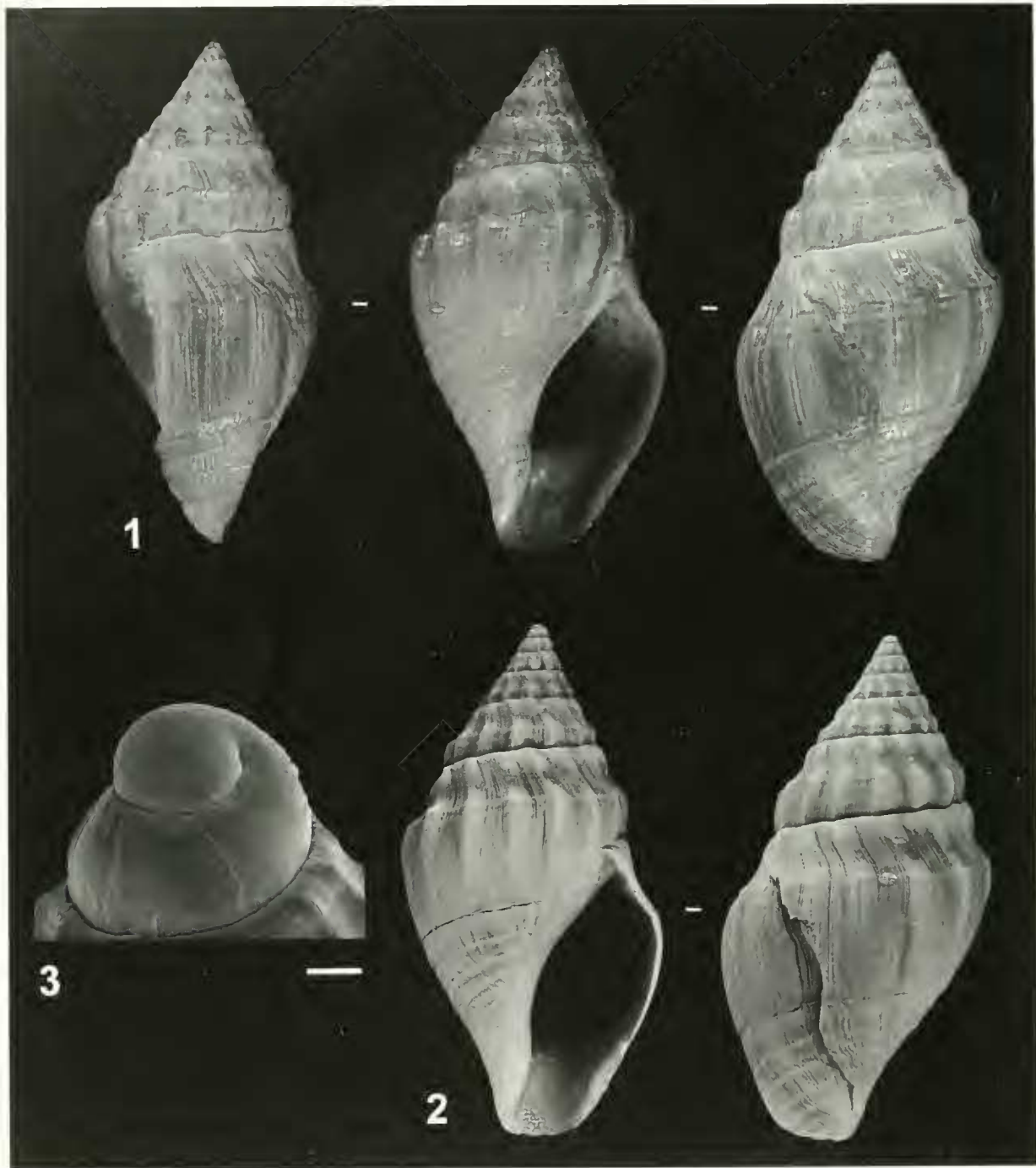
Genus *Fusulculus* new genus

**Type species:** *Fusulculus crenatus* new species

**Description:** Small pseudolivid with relatively high-spired, fusiform shell in which the spire comprises 33 to 39% of total shell height; shell consisting of one protoconch whorl [in species with non-planktotrophic development] and three to six teleoconch whorls; teleoconch whorls separated by impressed sutures; base of last whorl constricted above short siphonal canal; sculpture of last whorl consisting of axial riblets on adapical part of whorl, crossing finer spiral cords; conspicuous spiral groove below middle of last whorl, ending in very small labral tooth at edge of outer lip; below the groove, surface adorned with stronger spiral cords; inner side of outer lip smooth; anterior siphonal notch very shallow; fasciole, umbilical slit, and parietal rib absent; columellar callus of very limited extent, thin; adapical end of outer lip with obsolete notch. Operculum lanceolate, nucleus terminal. Radula with broad, slightly concavely arched rachidian, with three strong medially placed cusps, central one stronger; lateral teeth with strong, solid base, and short, claw-like cusp.

**Etymology:** Combination of *fusus* (Latin: spindle) and *sulculus* (Latin: small groove).

**Remarks:** *Fusulculus* belongs to a group of Pseudolividae in which the columellar and parietal callus is of very limited extent, and in which a parietal rib at the adapical end of the inner lip is absent. Among Recent genera, *Fusulculus* is most similar to *Benthobia* Dall,



Figures 1–3. *Fusulculus crenatus* new genus, new species, New Hebrides Arc, 22°17'S, 171°18'E, 450–550 m. 1–2. Holotype, height 16.5 mm; 1. Natural view; 2. Coated to enhance sculpture. 3. Protoconch, scale bar = 200  $\mu$ m.

1859 (type species: *B. tryonii* Dall, 1889) and *Zemira* H. & A. Adams, 1853 (type species: *Eburna australis* G. B. Sowerby I, 1833). All three genera are characterized by a very shallow siphonal notch, a spiral external groove that is situated just below the middle of the last whorl, by having the inner side of the outer lip smooth, and by lacking a fasciolar ridge bordering the anterior notch. Axial riblets confined to the subsutural ramp and should-

der are characteristic of *Fusulculus* as well as of *Benthobia* and of the Late Oligocene Australian species *Zemira tessellata* Tate, 1894 (see Ponder & Darragh, 1975; Bouchet & Warén, 1985). *Fusulculus* further resembles *Benthobia* in having the labral tooth obsolete, and by being basally slightly constricted; but it differs from *Benthobia* by having shouldered instead of evenly rounded whorls, by having a higher spire (spire comprising 33 to

39% instead of 25% of shell height), and a much less inflated and more elongate last whorl, and by having fine instead of obsolete spiral sculpture. *Fusulculus* resembles *Zemira* in having a moderately high spire (spire about 33% of total shell height in *Z. australis*) and in possessing fine spiral sculpture; but it differs in having the last whorl basally constricted instead of convex-sided and conical, by having appressed instead of deeply channeled sutures, and in having an obsolete instead of prominent and sharp labral tooth. Most species of *Zemira*, moreover, lack axial sculpture.

In Recent faunas, two other genera with limited callus development and without a parietal rib are *Luizia* Douvillé, 1934 (type species: *Buccinum (Luizia) costae* Douvillé, 1934; Miocene, Angola) and *Naudoliva* Kilburn, 1989 (type species: *N. caitlinae* Kilburn, 1989; south-eastern Africa). *Luizia* resembles *Fusulculus* in having axial riblets on the upper part of the whorls, by having appressed sutures, and by the relatively high position of the groove on the last whorl; but it differs from *Fusulculus* in usually being lower-spired (spire comprising 20% of shell height in *L. zebra* (A. Adams, 1855) from Angola, instead of 33 to 39%), in having the inner side of the outer lip finely lirate instead of smooth, by having a distinct labral spine, and in lacking the basal constriction of the last whorl. *Naudoliva*, like *Fusulculus*, is relatively high-spired (spire comprising 36% of total shell height) and basally constricted, and the inner side of its outer lip is likewise smooth; but it differs from *Fusulculus* in having a long labral spine, which is situated at the end of a slightly raised spiral band near the base of the shell rather than at the end of a groove that is situated at a high position on the whorl. *Naudoliva*, moreover, has a siphonal fasciole, which is lacking in *Fusulculus*.

The Late Cretaceous to Late Eocene genus *Calorbama* Squires, 1989 (type species: *Pseudoliva dilleri* Dickerson, 1914; California) is characterized by a broadly fusiform shell with a moderately low spire (spire comprising less than 27% of total shell height), eight to twelve axial folds often raised as nodes at the shoulder or periphery, and fine spiral sculpture over the whole whorl surface, as well as by the absence of a parietal thickening and of outer-lip lirae. As in *Fusulculus*, the spiral groove is located at a relatively high position on the whorl. *Calorbama* differs from *Fusulculus* by its lower spire, and by having a conical or evenly convex last whorl instead of a basally constricted body whorl. The axial sculpture of *Fusulculus* is finer.

*Fusulculus crenatus* new species  
(Figures 1–4, 6)

**Type material:** Holotype (dd) in MNHN; paratypes in NMNZ (1 dd), NM (1 dd), LACM (1 dd) and MNHN (2 lv, 7 dd).

**Type locality:** New Hebrides Arc, 22°17'S, 171°18'E, 450–550 m [VOLSMAR sta. DW30].

**Material examined:** Coral Sea. MUSORSTOM 5: sta. 313, 22°24'S, 159°33'E, 780–930 m, 4 dd.—Loyalty Basin. BIOGEOCAL: sta. DW289, 20°36'S, 167°00'E, 830–840 m, 3 dd.—New Hebrides Arc. VOLSMAR: sta. DW30, 22°17'S, 171°18'E, 450–550 m, 2 lv, 11 dd (type material).—Wallis & Futuna. MUSORSTOM 7: sta. DW540, 12°27'S, 177°28'W, 600 m, 1 lv, 12 dd.; Sta. DW578, 13°08'S, 176°16'W, 640–730 m, 2 dd.; Sta. DW586, 13°11'S, 176°13'W, 510–600 m, 2 dd (all MNHN).

**Distribution:** SW Pacific, from the Coral Sea to NE of Fiji, alive in 550–600 m, shells to 830 m.

**Description:** Shell thick, solid, ovoid, consisting of 0.9 protoconch and 5.7 teleoconch whorls, protoconch with smooth glassy shell, teleoconch more chalky, with thin and fragile intritacal and strong incremental lines, most distinct in lower parts of shell surface between ribs. Teleoconch whorls convex with a distinctly concave subsutural ramp occupying about 2/3 of exposed height of spire whorls. Sculpture consisting of strong axial ribs, 14 per whorl, and weaker spiral cords; one adapical cord just adjacent to suture, no cord but only very indistinct spiral threads in subsutural ramp, 2 cords below ramp (5 on penultimate whorl), forming prominent nodules at intersection with ribs. Last whorl with ca. 10 cords adapically of groove, those on shoulder stronger, 6 abapically with interspaces broader than cords; groove narrow and sharp, terminating in a short, pointed triangular tooth at aperture; axial ribs not extending abapically of groove. Aperture ovate with broadly open siphonal notch, columella simple; outer lip not thickened, regularly convex except for constriction at level of subsutural ramp. Color salmon brown with whitish intritacal on very fresh shells, fading in dead collected specimens. Operculum (figure 6) lanceolate, nucleus terminal. Radula (figure 4) with broad, slightly concavely arched rachidian, with three strong medially placed cusps, central one stronger; lateral teeth with strong, solid base, and short, claw-like cusp.

**Dimensions:** Holotype height 16.5 mm, diameter 7.9 mm, aperture length 10.4 mm, aperture width 4.0 mm. Largest specimen, height 18.4 mm.

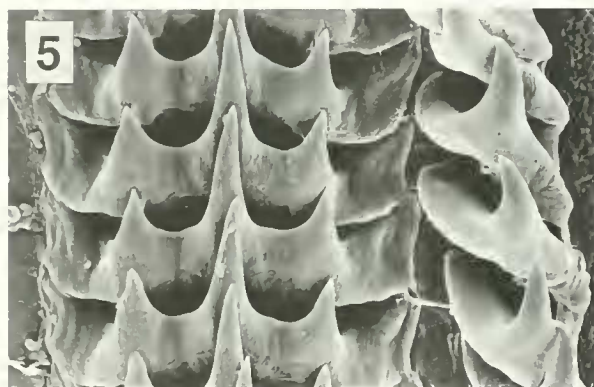
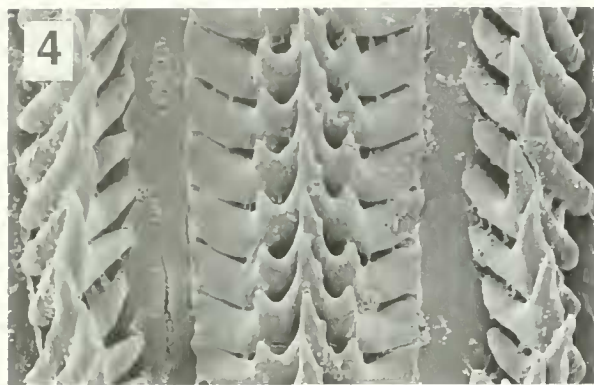
**Remarks:** A comparison with *F. albus* is given under the latter species.

*Fusulculus albus* new species  
(Figures 5, 7, 8–14)

**Type material:** Holotype (dd) in MNHN; paratypes in NMNZ (1 dd), NM (1 dd), LACM (1 dd) and MNHN (3 lv, 15 dd).

**Type locality:** North of New Caledonia, 18°42'S, 163°13'E, 668 m [MUSORSTOM 4 sta. DW160].

**Material examined:** New Caledonia (all MNHN). MUSORSTOM 4: sta. DW160, 18°42'S, 163°13'E, 668 m, 3 lv, 19 dd (type material.); BIOCAL: sta. DW48,



Figures 4–5. Radulae of *Fusuleculus* species. 4. *Fusuleculus crenatus* new species, taken from paratype from type locality, scale bar = 50  $\mu\text{m}$ . 5. *Fusuleculus albus* new species, taken from paratype from type locality, scale bar = 20  $\mu\text{m}$ .

Figures 6–7. Opercula of *Fusuleculus* species. 6. *Fusuleculus crenatus* new species, from paratype from type locality, length 6.5 mm. 7. *Fusuleculus albus* new species, taken from paratype from type locality, length 2.85 mm.

23°00'S, 167°29'E, 775 m, 2 dd.; BATHUS 4: sta. DW917, 18°47'S, 163°14'E, 397–400 m, 5 dd.—New Zealand. Three Kings Rise. R.V. Acheron, sta. BS391, 34°01'S, 172°07'E, 622 m, 7 dd (NMNZ M34932); R.V. Tangaroa, sta. BS633, 34°20'S, 171°48'E, 440 m, 4 dd (NMNZ M100323); Sta. BS634, 34°18'S, 171°45'E, 427 m, 2 dd (NMNZ M100322); Sta. BS896, 34°01'S, 171°45'E, 201–216 m, 1 dd, 1 fragm. (NMNZ M100324); Sta. BS898, 34°01'S, 171°44'E, 206–211 m, 1 dd (NMNZ M100321); NZOI sta. U602, 31°31'S, 172°50'E, 1216–1385 m, 1 dd (NZOI).

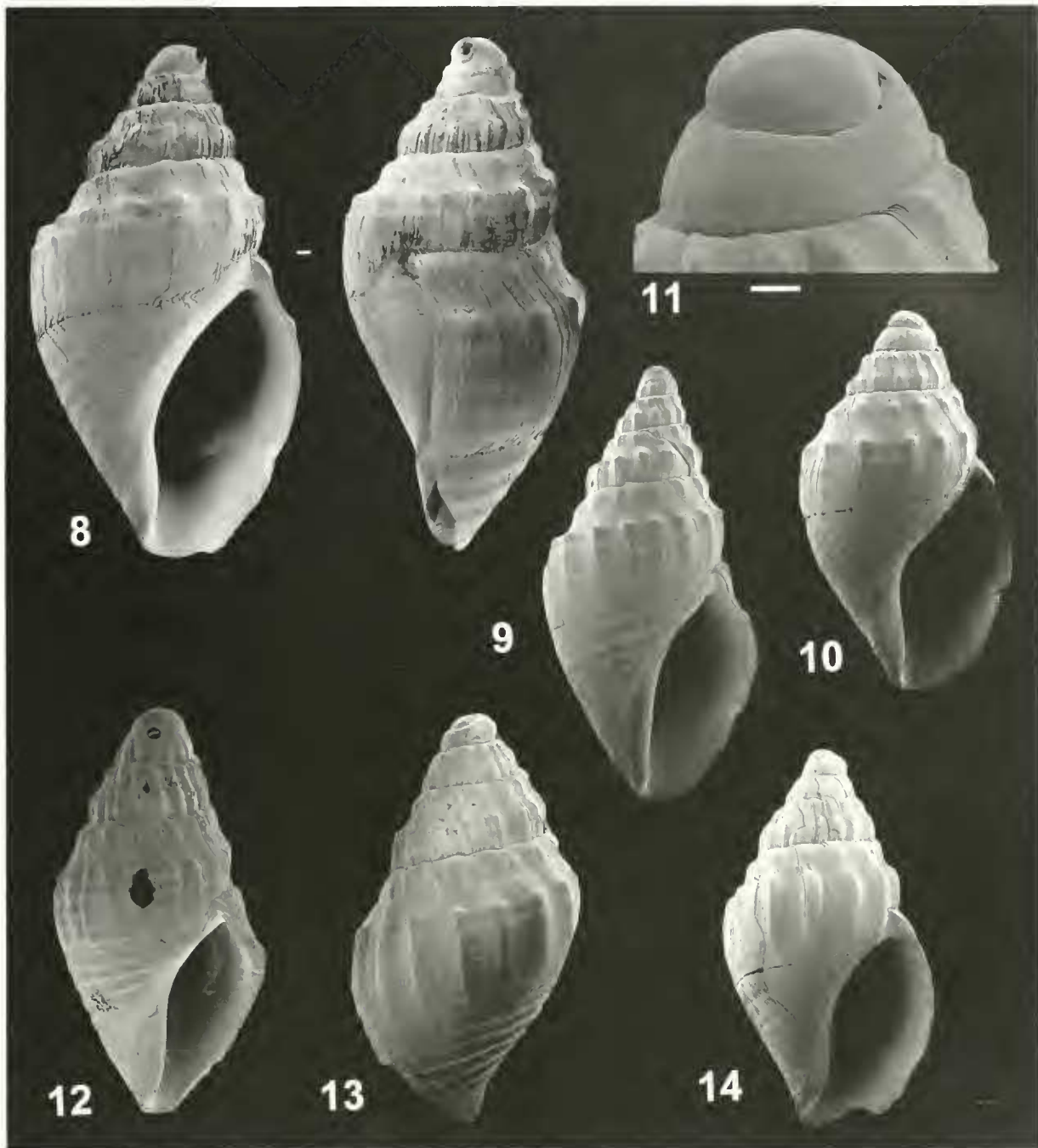
**Distribution:** New Caledonia, alive in 668 m, shells in 400–775 m; north of New Zealand, Three Kings Rise, shells in 211–622 m, with a single shell, probably transported vertically, in 1216–1385 m.

**Description:** Shell thick, solid, ovoid, consisting of 0.8 protoconch and 3.2 teleoconch whorls, protoconch with smooth glassy shell, teleoconch more chalky, with thin and fragile intritacalx and strong incremental lines, most distinct in lower parts of shell surface between ribs. Teleoconch whorls convex with a distinctly concave subsutural ramp occupying nearly half of exposed height of spire whorls. Sculpture consisting of low, broad axial ribs and low spiral cords, indistinct except at their intersection with ribs; one adapical cord just adjacent to suture, no cord in subsutural ramp, 3 cords below ramp, most adapical one forming prominent nodules at intersection with ribs, most abapical one very indistinct. Last whorl with 4 cords adapically of groove, 5 abapically; groove very sharp, terminating in a pointed triangular tooth at aperture; axial ribs not extending abapically of groove. Aperture ovate with broadly open siphonal notch, columella simple; outer lip not thickened, regularly convex except for a slight constriction at level of subsutural ramp and at level of groove. Color white. Operculum (figure 7) and radula (figure 5) as in *F. crenatus*.

**Dimensions:** Holotype height 7.9 mm, diameter 4.0 mm, aperture length 4.8 mm, aperture width 2.15 mm. Largest specimen [BATHUS 4 sta. DW917], height 10.3 mm.

**Remarks:** *Fusuleculus albus* differs from *F. crenatus* by having a smaller adult size, by being white instead of salmon brown in colour, and by having the axial riblets mainly confined to the shoulder area instead of extending from the suture to the groove. *Fusuleculus albus* is in these respects more like *Benthobia* than is *F. crenatus*. The two species co-occur in the New Caledonia region, but are never syntopic, nor sympatric.

The material from Three Kings Rise all consists of empty, sometimes worn or fragmentary shells. General shell morphology and proportions are similar to the material from New Caledonia. Most specimens have broadly spaced axial ribs and only weak spiral cords adapically of the spiral groove, thus the shoulder is not muricated as in the New Caledonia specimens (figure 14). One sample differs by having more numerous axial



**Figures 8–14.** *Fusulculus albus* new species. **8.** Holotype, height 7.9 mm, north of New Caledonia, 18°42'S, 163°13'E, 665 m. **9.** High-spined specimen, height 10.3 mm, north of New Caledonia, 18°47'S, 163°14'E, 397–400 m. **10–11.** Low-spined specimen, height 6.2 mm, south of New Caledonia, 23°00'S, 167°29'E, 775 m; **11.** Protoconch, scale line = 200  $\mu$ m. **12–13.** Specimens from Three Kings Rise, height 6.5 and 5.9 mm respectively, north of New Zealand, 622 m (NMNZ M34932). **14.** Specimen with weak spiral sculpture, height 7.1 mm, North of New Zealand, 440 m (NMNZ M100323).

ribs and strong spiral sculpture, extending adapically of the spiral groove (figures 12–13). Despite these differences, we interpret the New Caledonia and New Zealand material as probably representing a single species with discontinuous distribution along the Norfolk Ridge.

#### BIOGEOGRAPHICAL REMARKS

The family Pseudolividae was distributed nearly worldwide during the Late Cretaceous and Paleogene, but it has become progressively biogeographically restricted during the Neogene. In Recent seas, the family is rep-

resented in abyssal and bathyal waters by *Benthobia*, which is known from the deep Atlantic, Indian Ocean, and New Zealand (see Bouchet & Warén, 1985; Kantor, 1991). Shallower-water genera are known from New Caledonia (*Fusulculus*), temperate Australia (*Zemira*), warm-temperate southeastern Africa (*Naudoliva*), temperate and tropical western Africa (*Pseudoliva* Swainson, 1840; *Fulmentum* Fischer, 1884; *Luizia*), and western warm-temperate North America (*Macron* H. & A. Adams, 1853) and the Panamic Province (*Triumphis* Gray, 1857) (see Vermeij, 1998). During Miocene and Pliocene time, the family was also represented in temperate western South America by *Testallium* Vermeij and DeVries, 1997.

Beside the abyssal species of *Benthobia*, *Fusulculus* is the only genus of Pseudolividae known from moderately shallow water in the vast Indo-West Pacific region since Paleocene time. The family disappeared from Europe and Japan after the Late Eocene.

#### ACKNOWLEDGEMENTS

We thank Bruce Marshall (NMNZ) who brought our attention to the material of *Fusulculus* under his care, and

Anders Warén (Naturhistoriska Riksmuseet, Stockholm) who prepared the radulae for scanning electron microscopy. The research was funded in part by a grant (NSF EAR-94-05537) from the National Science Foundation to Vermeij.

#### LITERATURE CITED

- Bouchet, P. and A. Warén. 1985. Revision of the northeast Atlantic bathyal and abyssal Neogastropoda excluding Turridae (Mollusca, Gastropoda). *Bollettino Malacologico*, Suppl. 1:123-296.
- Kantor, Yu.I. 1991. On the morphology and relationships of some oliviform gastropods. *Ruthenica* 1:17-52.
- Ponder, W. F. and T. A. Darragh. 1975. The genus *Zemira* H. and A. Adams (Mollusca: Gastropoda). *Journal of the Malacological Society of Australia* 3:89-105.
- Vermeij, G. J. 1998. Generic Revision of the Neogastropod Family Pseudolividae. *The Nautilus* 111(2):53-84.
- Vermeij, G. J., and T. J. DeVries. 1997. Taxonomic remarks on Cenozoic pseudolivid gastropods from South America. *The Veliger* 41:23-28.